PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES OR OF LIMITED DISTRIBUTION, NO. 22: GIANT AFRICAN SNAIL

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Order: Family	Stylommatophora: Achatinidae
Pest	GIANT AFRICAN SNAIL Achatina fulica Bowdich

Economic Importance

This species is one of the most serious land snail pests known, reported to consume all growth stages of vegetables, cover crops, garden flowers, herbaceous ornamentals, and damaging many fruit and ornamental trees. In 1969, Florida estimated that an $11 million annual loss would be inflicted by this snail if it were unchecked.

A large infestation presents a nuisance problem with slime trails, excretions, and odors of decay when they die in large numbers. They also deface buildings by feeding on any material containing calcium, such as paint. Their dead bodies create health hazards by polluting wells and other water sources. Feeding on human, pet, and livestock excrement, may spread disease (U.S. Department of Agriculture 1970, Mead 1961).

During the past decade, A. fulica has been shown to transmit the rat lungworm, Angiostrongylus cantonensis (Chen), which causes eosinophilic meningoencephalitis in humans. This snail has also been shown to transmit Aeromonas hydrophila (Stainer), which causes several chronic, resistant disease conditions. Recently this bacteria has been found not only in a number of infrahuman, warmblooded species but in a surprising number of human pathologies. Some of these include acute bacteremia, osteomyelitis, septic arthritis, tonsillitis, and meningitis. A. fulica has also been implicated in transmitting the following plant pathogens: Phytophthora palmivora (Butl.) on commercial pepper, coconut, betel pepper, papaya, and vanda orchid; Phytophthora colocasiae Rac. on taro; Phytophthora parasitica Dast. on eggplant and tangerine.

On the positive side, the market for this snail species as food is expanding. This is leading to a reverse in thinking of this snail as a pest, especially in Taiwan. The snail is also useful in making fertilizer and chicken feed. Just beginning is the discovery that A. fulica and other giant snail species are valuable sources of biological compounds of unsuspected properties useful in clinical and experimental laboratories, particularly in Africa and

Asia. This scavenger performs an incidental benifit by consuming all sorts of unwanted offensive matter more rapidly than bacteria or fungi (Mead 1961 and 1979).

Hosts

This species is basically a scavenger, consuming all sorts of decaying organic matter: Excrement, dead and rotting plants and animals even soggy cardboard. This scavenger role complicates what is a "host" (Mead 1961).

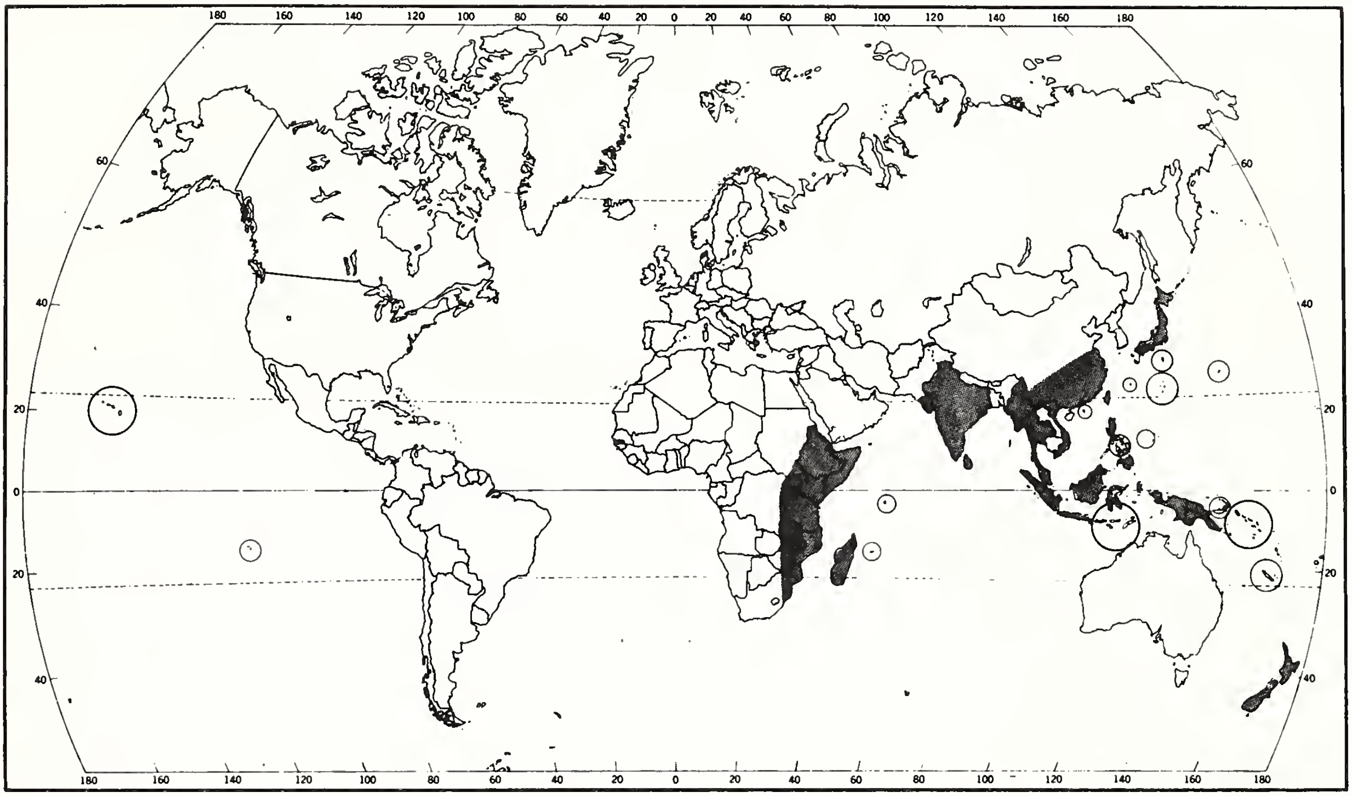
Although many plants of little economic value are eaten, the majority of the snail's hosts are cultivated plants. These include: All types of vegetable crops, such as lettuce, bean, pumpkin; cole crops such as cauliflower and cabbage; ornamentals such as marigold, portulaca, and zinnia. *A. fulica* also causes damage to coffee, rubber, and areca-nut plantations. Leguminous cover crops suffer considerably. Citrus fruit and citrus seedlings are also reported to be damaged (Srivastava 1973 and 1970, Denmark 1969).

Cuttings and seedlings of hosts not attacked in the mature state, e.g. breadfruit, casava, and treak, are completely consumed or have their bark removed. Overall, rubber is not damaged critically but the snails are a nuisance on trees being tapped because of their unique appetite for fresh rubber latex.

Giant African snails have been known to feed on fruits such as papaya and banana. All parts of the papaya plant are attacked, the fruit being one of the few actually primarily damaged to a great extent. The snails generally prefer rotting and therefore already damaged fruit.

Very little damage is done to all members of the grass family which includes sugarcane, corn, rice, and the small grains. This is universally true in all areas of the world. Other starchy crops such as taro and sweet potato are as immune, although the cassava suffers some damage and the yam is seriously attacked. Coconuts, pineapple, pandanus, coffee, and tea are also little damaged.

Indirect damage can be caused even to plants not eaten, such as breakdown due to the weight of excessive numbers of snails. An ironic twist is supplied by the land used for tea growing being rendered unfit due to attempts to get rid of the snails by collecting and burying them. The shells make the soil too alkaline for the acid-loving tea plants to grow (Mead 1961 and 1979).



Achatina fulica map prepared by USDA, APHIS, PPQ, Biological Assessment Support Staff

General Distribution

The giant African snail is native to eastern Africa. In 1936 it became established on the island of Hawaii and has since spread to every island. An infestation discovered in Florida in 1969 has been eradicated. It has also been introduced into Southeast Asia, Bismarck Archipelago, Bonin Islands, Borneo, Caroline Islands, Southeast China, Guam, Hong Kong, India, Indonesia, Japan, Malaysia, Maldive Islands, Mariana Islands, Mauritius, New Britian, New Caledonia, New Guinea, New Ireland, New Zealand, Okinawa, Papau Islands, Philippines, Reunion, Ryukyu Islands, Sarawak, Seychelles, Sri Lanka, Tahiti, Taiwan, Thailand, and Vietnam (Denmark 1969, Burch 1960, U.S. Department of Agriculture 1970, Mead 1961).

Specimens have been intercepted approximately 96 times from 1971 through 1981 at various U.S. ports of entry (U.S. Department of Agriculture 1981).

Characters

Generally, the color and shape of snail shells take various forms, and are strongly affected by environment and diet. Some shells are unicolorous olivaceous tan while others are much darker.

ADULTS - Length usually 125 mm or more, typically yellowish or horn-colored, with reddish brown axial streaks. Whorls spirally striate, and rounded with moderately impressed sutures. Aperture ovate-lunate to roundly lunate. Outer lip sharp and not reflected. Columella abruptly truncate (Burch 1960).

(Fig. A)

A. A. fulica adult

EGGS - Elyptical, about 4 mm by 5 mm in diameter, usually pale yellow, laid in clutches of 100-400.

IMMATURES - Length 4 mm, and increase 10 mm per month for first 4 months. Coloration similar to adults (Denmark 1969).

Characteristic Damage

Snails of all stages feed on the stems and foliage of plants. Infestations weaken plants and delay growth, often causing death. This pest has also stripped some tropical vegetable gardens of leaves, flowers, and tender

pieces of bark (Nair and Sadanandan 1974). Cover crops are prevented from producing green manure, shade, soil retention, and nitrogen fixation. It is believed that the greatest damage is found in new infestation sites or at the crest of expanding populations (Mead 1961 and 1979).

Detection Notes

1. Survey any time of the year, especially after dark in moist and sheltered places. Surveying is ideal in warm, wet weather.

2. Check plant material for extensive rasping signs, defoliation, slime trails, or ribbonlike excrement.

3. Collect and submit snails completely submerged in 70% alcohol. Empty shells may be shipped dry (California Department of Food and Agriculture 1971).

Biology

Although its average life span is about 3 years, giant African snail has been reported to live 6 years. They are hermaphroditic but cross-fertilization apparently is required. The number of matings required for full egg production potential is unknown. Under test conditions, isolated individuals can lay viable eggs for 382 days after mating. Egg laying begins at 5-6 months with individuals producing 300+ eggs in 1 clutch per year. Under optimum conditions, 4 clutches of 150 eggs can be laid each year. Eggs are deposited in cool, moist soil and under objects on the ground. After the eggs hatch (11-day incubation period in the tropics), the juveniles eat the egg shell before seeking other food.

Although this species is normally nocturnal, it may become active at twilight, when the day is overcast and the soil is moist and warm. The snail is extremely sensitive to conditions of high evaporation rates. It becomes inactive and begins estivating within 24 hours under a slight moisture stress. Snails have also been observed to enter estivation without a moisture stress. Because of this it is believed that estivation may be cyclic. Estivation can occur as snails cling to solid objects, aiding in spread to new areas by artificial means.

During unfavorable periods, the snail buries itself 10-15 cm in soft soil and may become inactive up to a year, losing 60% of its weight. Physiological changes in blood and certain organs occur before and during the period of inactivity. The ability to withstand trauma and an extensive shell loss indicates a general physical hardiness.

Scientific literature on the physiology of *A. fulica* is scarce. Estivation and hibernation are confusing and can be distinguished only by trained malacologists.

Behavior, size, and shape of the snail vary, permitting rapid adaptation to new environments. These variations could allow adaptations to colder and drier climates, and also a range extension farther north than is presently known. The exact ecological range is unknown; however, it can probably be predicted from combinations of temperature (minimum of -1.1°C), moisture (near subtropical rainfall), and available lime (soil origin and a pH of 7.0-8.0).

This species requires high levels of lime to prosper, due to its rapid growth rate and large size. There is a high positive correlation between available lime in the soil and the abundance of this snail. However, the lack of enough soil lime does not form a complete barrier. Abundant populations have been found in tea-growing areas where the typical soil pH is 4.5, and calcium carbonate could not possibly last long, especially in the presence of abundant moisture. Giant African snail can get enough lime from scavaging on fallen leaves because plants are able to extract the bound lime from the soil and concentrate it in the leaves.

Temperature and moisture are the most limiting factors. These factors should predict the northern limits of its ecological range with acceptable precision. This species is well adapted to tropical and subtropical climates and is abundant as far north as 30° latitude. In the Western Hemisphere, survival and establishment are likely in the area bordering the Gulf of Mexico (from Florida to Texas), in the irrigated desert areas of southern California, and also many parts of Mexico and Central America (U.S. Department of Agriculture 1970, Mead 1961).

Controls

The general methods for controlling land mollusks include: Mechanical crushing, grinding, handpicking, and trapping; physical manipulation of moisture and temperature; chemical attractants, baits, repellents, and toxicants; agronomic practices; and biological introduction of diseases, parasites, and predators. Mollusk control usually involves repeated broadcasting of poisoned baits. Biological control has been widely used because manpower and technology to develop and practice other methods are not available or justified (U.S. Department of Agriculture 1970, Mead 1961).

To date, some of the most important predators of the giant African snail include: Insects, 5 species of Lampyridae (Coleoptera), primarily Lamprophorus tenebrosus (Walker); crabs, primarily hermit crab (Oenobita perlatus) (Milne Edward), and rubber or coconut crab (Birgus latro (L.)); and snails, Edentulina affinis (C. R. Boettger), Gonaxis quadrilateralis (Preston), Gonaxis kibweziensis (E. A. Smith), and Euglandina rosea (Ferussac), which is native to the Gulf States. Efforts to use predators and parasites for control on the Hawaiian Islands have not been very successful (Mead 1961, U.S. Department of Agriculture 1970). Furthermore, the introduction of snail predators is believed to have resulted in unwanted predation on endemic tree snails (Achatinella spp.) (Bender 1981).

An endemic disease syndrome of giant African snail will become epidemic under population stress. This corresponds with the earlier observed rise and fall of populations following introduction into new territory. The snails normally build up to extremely high densities, decline within several years, and become incidental. Presently, the cause and means of using this disease syndrome for control is under investigation. Authorities believe that ants, birds, centipedes, cestodes, flies, fungi, mammals, millipedes, mites, nematodes, protozoans, and reptiles have growing potential and need more research (Mead 1979).

A striking reduction of giant African snail populations has resulted from the accidental introduction of a flatworm (Geoplana sp.) into Guam. This predator, first observed in 1978, is fast growing and has spread over the entire island. This flatworm has also been reported to have been established on Saipan in the same manner. Members of this genus have been observed devouring snails in Hawaii since 1907 and are probably vectors of the above-mentioned disease syndrome, but the use of these worms as control agents has never been fully explored because of general doubt that they would be effective, and might have some disadvantages. Geoplana spp. have been shown to also carry the eosinophilic meningoencephalitis (mentioned above) to humans (Muniappan 1981, Mead 1963).

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